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Field Comparison of Five Pavement Marking Removal Technologies

FINAL REPORT

Prepared For:

Utah Department of Transportation Research Division

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This paper reports on the effectiveness of five different methods of pavement marking removal, including diamond grinding, carbide grinding, hydraulic blasting, dry ice blasting, and soda blasting. The measures of effectiveness used were a quantitative measure of speed of removal and a subjective discussion of surface preparation and the pros and cons of each technology,</td></tr>
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EXECUTIVE SUMMARY

A demonstration of five different pavement marking removal systems was presented in May of 2008. The five methods were diamond grinding, carbide grinding, hydraulic blasting, dry ice blasting, and soda blasting. Each of the technologies was applied to sections of chip seal pavement, and Portland cement concrete (PCC) pavement.

The two grinding technologies are still the most effective in removing lines quickly and providing a clean, prepared surface for marking installation. The soda and dry ice technologies should be investigated for possible use where space is limited or other specialized removal needs are present, but are not yet comparable to the production rates of the grinding or water blasting equipment. The amount of dust generated by the soda blasting technique should be factored into a manager's decision to use that technology.

The water blasting technology is the most effective at marking removal with the least amount of damage to the pavement and should be investigated for possible use by the Department.

1.0 INTRODUCTION

On May 6, 2008 a field comparison of four different pavement marking removal technologies was conducted on SR-202. SR-202 is located between the town of Garfield and the Salt Air Historic Beach near Magna, Utah (Figure 1). The road has a chip seal surface that was striped two years ago with state specification waterborne paint. The road was closed from 12:00 noon until 4:00 PM. A fifth technology, soda blasting, was later demonstrated on June 23, 2008.

(Figure 1) Location map

Representatives from UDOT, FHWA Utah Division Office, Salt Lake County, Salt Lake City and the Airport Authority were in attendance.

2.0 RESEARCH METHODS

The objectives of the test were to compare the effectiveness of the removal technologies and the relative visibility of the remaining shadow lines.

Personnel from the Research Division of the Utah Department of Transportation (UDOT) attended the demonstration and video recorded the processes and measured the removal times.

3.0 APPLICATION OF TECHNOLOGIES

The five technologies used are as follows:

Diamond grinding (Appendix A)
Carbide grinding (Appendix B)
Hydraulic blasting (Appendix C)
Dry Ice blasting (Appendix D)
Soda blasting (Appendix E)

Each of the technologies was used on a selected stretch of chip sealed pavement, and then on a selected stretch of Portland Cement Concrete (PCC) pavement.

The vehicle-borne technologies (grinding and hydraulic blasting) were tested on 650’ sections of pavement that were marked with two-year old, white waterborne shoulder paint placed on a chip seal. On concrete, the test section was a 300’ stretch of waterborne paint placed over the top of existing white, epoxy shoulder paint.

The blasting technologies (dry ice and soda) were tested on fifty-foot sections of the same pavement on which the vehicle-borne technologies were applied.

4.0 DATA COLLECTION

Quantitative data included the length of pavement marking removed per unit time, and the depth and width of marking removal when used on chip seal.
The qualitative data collected is in the form of images that were exported from the video.

4.1 Quantitative data

Table 1 summarizes the speed of each of the 5 removal technologies, in descending order, on the chip seal surface. The tests on chip seal were conducted on the north bound shoulder of SR-202. The tests on concrete were conducted on the eastbound off-ramp of I-80 as it turns onto SB SR-202. Both locations were tested on 5/6/08.

On 6/23/08 the soda blasting technology on the chip sealed surface was tested on the north bound shoulder of SR-202 using three separate nozzles. The tests on concrete were conducted on the I-80 west bound on ramp at the 7200 South interchange using only one nozzle.

Removal Rates on Chip Seal						
Process	**Depth Setting**	**Head Width (in.)**	**Head Type**	**Distance (ft.)**	**Time (sec.)**	**Ave. Speed (ft./sec.)**
Carbide Grind	20 mils	6	Grinding heads	650	295	2.20
Diamond Grind	20 mils	5.5	Grinding heads	650	336	1.93
Hydro Blast	none, floats on surface	12	Blasting head	650	356	1.83
Soda Blast-3rd	none, held above surface	12	Hand-held wand	20	139	0.14
Soda Blast-2nd	none, held above surface	n/a	Hand-held wand	20	193	0.10
Soda Blast-1st	none, held above surface	n/a	Hand-held wand	20	252	0.08
CO_2 Blast	none, held above surface	n/a	Hand-held wand	4	240	0.02

(Table 1) Removal rates on chip seal, fastest to slowest, in descending order

Removal Rates on Concrete						
Process	**Depth Setting**	**Head Width (in.)**	**Head Type**	**Distance (ft.)**	**Time (sec.)**	**Ave. Speed (ft./sec.)**
Carbide Grind	20 mils	6	Grinding heads	300	222	1.35
Diamond Grind	20 mils	5.5	Grinding heads	300	313	0.96
Hydro Blast	none, floats on surface	12	Blasting head	300	399	0.75
Soda Blast	none, held above surface	n/a	Hand-held wand	8.66	372	0.02
CO_2 Blast	none, held above surface	n/a	Hand-held wand	1.33	120	

(Table 2) Removal rates on concrete, fastest to slowest in descending order

4.2 Visual data

Below is the visual data gathered:

4.2.1 Dry ice Blasting

(Figure 2) Results of dry ice blasting on chip seal using a hand-held wand (note the marking material is completely removed but the surface is pitted. The dry ice dissipated into the air leaving no residuals.)

(Figure 3) Results of dry ice blasting technique on concrete (note the marking material is completely removed and the surface is free from pitting with a faint shadow line.)

4.2.2 Carbide Grinding

(Figure 4) Results of carbide grinding technique on chip seal (note the marking material is completely removed but a shadow line still remains)

(Figure 5) Results of carbide grinding technique on concrete (note the marking material is partially removed and a shadow line still remains)

4.2.3 Diamond Bit Grinding

(Figure 6) Results of diamond grinding technique on chip seal (note the marking material is removed and a shadow line remains)

(Figure 7) Results of diamond bit grinding technique on concrete (note the marking material is removed and a shadow line remains)

4.2.4 Hydraulic blasting

(Figure 8) Results of hydraulic blasting on chip seal while still wet.

(Figure 9) Results of hydraulic blasting on chip seal after drying. Note a shadow line still remains and the material is completely removed.

(Figure 9) Results of hydroblaster technique on concrete while still partially wet. Note the marking material is completely removed and a shadow line still remains)

4.2.5 Soda Blasting

(Figure 10) Bicarbonate blasting technique on chip seal. Note the residual dust created during the blasting process.

(Figure 11) Results of soda blasting technique on chip seal. Note marking material seems completely removed and a shadow line still remains. Note, also, the residual dust on the road surface.

(Figure 12) Results of soda blasting technique on concrete. Note the marking seems completely removed and a faint shadow line still remains. Note, also, the residual dust on the road surface.

5.0 DATA EVALUATION/ANALYSIS

Data was compared in both quantitative and qualitative terms. The simplest comparison was the amount of pavement marking removed per unit time. The quantitative data factored in appearance of finished product, the effect a given technology had on the pavement (e.g. pavement was left wet, pavement was degraded, etc.), and other concerns that might arise through use of the technology (e.g. the generation of dust that obscures the road at the site).

6.0 CONCLUSIONS

Given that the data was both qualitative and quantitative, data evaluation will be presented as a series of “pros” and “cons” with regards to the individual technologies.

6.1.1 Dry Ice Blasting

"*Pros*": Dry ice blasting does not create environmental concerns. Pavement degradation on concrete was lower than any of the vehicle-mounted technologies, and the technique left no "shadow lines".
"*Cons*": Dry ice blasting had one of the lowest distance/time removal rates of the five technologies (averaging .015 feet/second). The technology also generated considerable noise and pitted the chip seal surface.

6.1.2 Carbide Grinding

"*Pros*": Removal speed of the pavement marking was the highest of the tested technologies. The surface was clean, dry, and ready for repainting immediately following grinding.
"*Cons*": Carbide grinding degraded the pavement during the grinding process. The grinding also left "shadow" lines, which were still visible particularly on PCC pavement.

6.1.3 Diamond Bit (COMAX) Grinding

"*Pros*": Removal speed of the pavement marking was comparable to carbide grinding. The surface was clean, dry, and ready for repainting immediately following grinding.
"*Cons*": Diamond grinding degraded the pavement during the grinding process. The grinding also left "shadow" lines, which were still visible, particularly on PCC pavement.

6.1.4 Stripe Hog Hydroblaster

"*Pros*": Removal speed of the pavement marking was comparable to carbide grinding. Thee Stripe Hog left no shadow lines, and caused less pavement degradation than the two grinding methods that were tested.
"*Cons*": The scoured surface remained wet for some time after the pavement marking removal. This could be a particular concern during periods of lower temperatures, when they drying time would increase.

6.1.5 Soda Blasting

"*Pros*": Pavement degradation was lower than any of the vehicle-mounted technologies, and the technique left no "shadow lines."

"*Cons*": Soda blasting had one of the lowest distance/time removal rates of the five technologies (ranging from .08 ft./sec to .14 ft./sec). The technology also generates dust, which can be a potential safety hazard by lowering the visibility at the work site.

7.0 RECOMMENDATIONS/IMPLEMENTATIONS

The two grinding technologies are still the most effective in removing lines quickly and providing a clean, prepared surface for marking installation. The soda and dry ice technologies should be investigated for possible use where space is limited or other specialized removal needs are present, but are not yet comparable to the production rates of the grinding or water blasting equipment. The amount of dust generated by the soda blasting technique should be factored into a manager's decision to use that technology.

The water blasting technology is the most effective at marking removal with the least amount of damage to the pavement and should be investigated for possible use by the Department.

APPENDIX A

Technology: Diamond Grinding

Contractor: Dunn-Rite Lines (formerly Comax)

(contact information not available at the time of this writing)

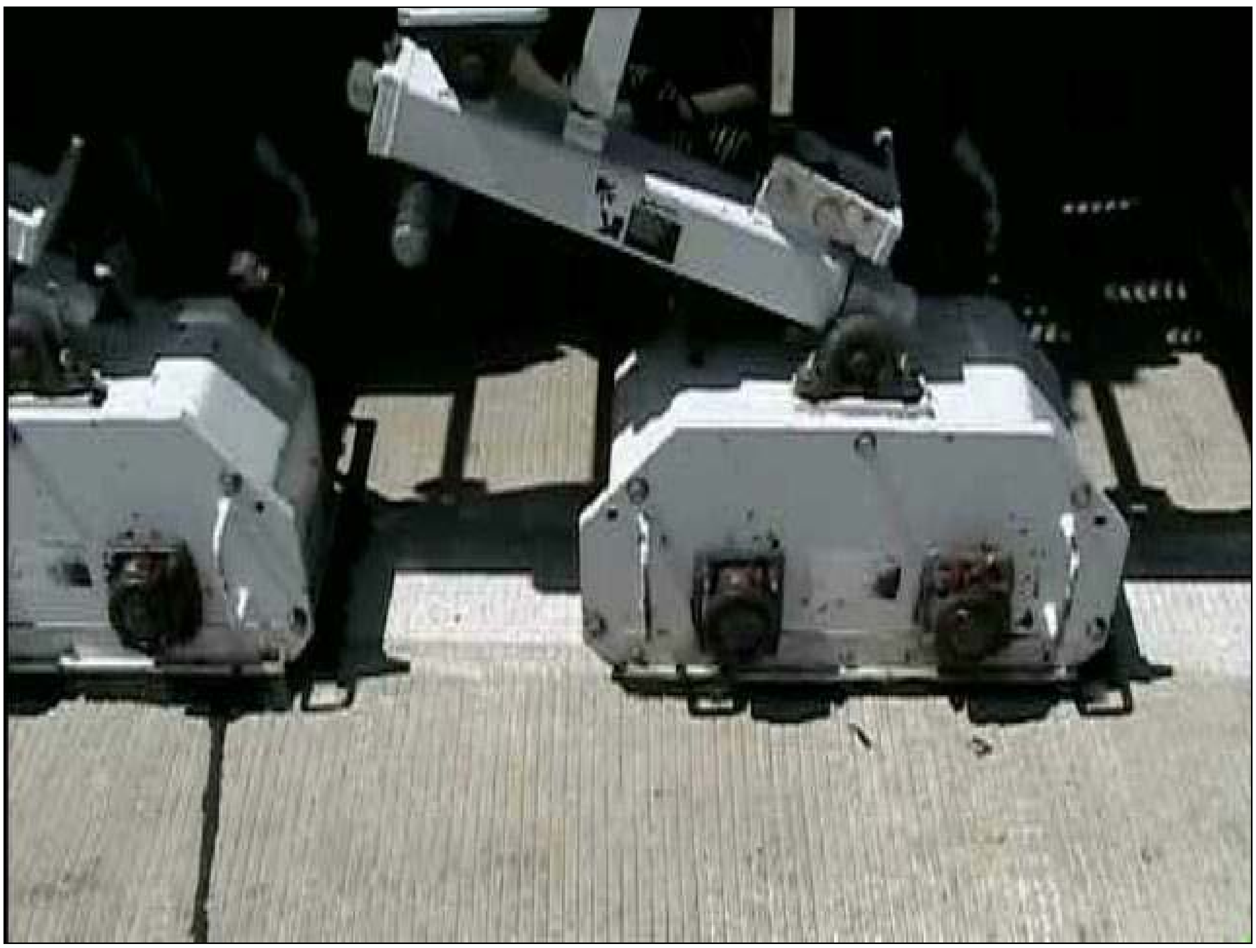
APPENDIX B

Technology: Carbide Grinding

Contractor: Interstate Barricades

858 McCormick

Layton, UT 84041-7200
(801) 546-0220



APPENDIX C

Technology: Hydraulic Blasting

Vendor: Waterblasting Technologies

3321 SE Slater Street

Stuart, FL 34997

(877) 964-7312 Toll-Free

www.waterblastingtechnologies.com

APPENDIX D

Technology: Dry ice

Dry Ice Blasting Service (DIBS)

2217 Cahabra Dr. Birmingham, AL

205-995-2412

APPENDIX E

Technology: Soda Blasting

Contractor: DLP Construction Co.
Doug Parker
2927 W. 10400 S.
South Jordan, UT 84095
801-446-0890 Office
801-301-3054 Cell

MaxxStrip™

Blast Media

TECHNICAL SPECIFICATIONS

Chemical name:	Kieserite
Bulk Density:	90 lbs./cu.ft.
Specific Gravity:	2.6
Color:	Almost White
pH:	7.0
Hardness:	3.5 Moh
Size Range:	COARSE 20-40 Mesh MEDIUM 40-60 Mesh FINE 64-80 Mesh

Environmentally Sound

Water soluble, non-toxic, neutral ph

Will not corrode copper, brass or aluminum substrates

Easy clean-up; will not harm foliage or micro organisms present for remediation

Will not damage or kill foliage or vegetation

Worker Safety In Mind

No solvents, caustic chemicals or free silica hazards in MaxxStrip Blast Media

Non-sparking, no explosive environment from airborne dust

Safe For Process Areas

Will not damage mechanical seals or bearings in rotating equipment

Removes mill scale and medium to heavy rust scale

Exceptionally useful in tube cleaning and fin fan units

Effective and Quick

Available in 3 mesh ranges for a variety of substrates

Will not corrode aluminum jacketing, damage brass or copper electrical contact closures

Can remove coatings, grease, rust or almost any foulant without having to shut down process streams

Benefits of water solubility with higher production rates than other water soluble abrasives

For technical sales and service:

Universal Minerals, Inc.

www.watersolubleabrasive.com

MaxxStrip™

MATERIAL SAFETY DATA SHEET

GENERAL INFORMATION

Manufacturer: **Universal Minerals, Inc.**
6319 Brookhill Drive
Houston,Texas 77087
713.797.0054 Phone
713.797.1014 Fax

Creation Date: 07/00

I. PRODUCT IDENTIFICATION

Trade Name:	MAXXSTRIP BLAST MEDIA
Formula:	Kieserite Blended Formulation
CAS No:	7487-88-9
Shipping Name:	Maxxstrip Blast Media (Not restricted article) D.O.T. Maxxstrip Blast Media (Not restricted article) I.A.T.A

II. INGREDIENTS

Non Hazardous:	100%
Hazardous:	None

III. PHYSICAL DATA

Bulk Density:	2.6 g/ cm^3
Odor:	Odorless
Appearance:	Almost white
Solubility in H_2O:	Yes
Ph (1% solution):	7.0
Melting Point:	1,130^{O} C

Universal Minerals, Inc.

6319 Brookhill Drive
Houston, TX 77087
http://www.universalminerals.com

Phone: 713-797-0054
Fax: 713-797-1014

PRODUCT DATA SHEET

MaxxStrip

Mineral Name: Kieserite

Chemistry(Dry Basis)	Typical %
MgO	27.6 %
S	23.0 %
Cl	0.2 %
$MgSO_4$	82.4 %
$CaSO_4$	4.2 %
K_2SO_4	0.3 %
KCl	0.3 %
$NaCl_2$	0.2 %
$MgCl_2$	—
H_2O ges.	12.6 %

PH 7.0
Water Soluble
Mohs Hardness 3.5

Size Range

Coarse	Medium	Fine
20-40 Mesh	40-60 Mesh	60-80 Mesh

DS:MXST05.18.05